CORRELATION BETWEEN CARIES PREVALENCE AND SOCIOECONOMIC STATUS IN CHILDREN AGES 6 TO 36 MONTHS

by

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INTRODUCTION

Twenty years ago, a study by Weddell and Klein[1] was conducted to determine the oral health status for children 6 to 36 months of age, born and reared in a community with an optimum fluoridated water supply, who were from various socioeconomic levels. The results of that study were useful to various agencies in identifying the dental needs and preventive programs for children in that age range.

Since then, few similar studies[2-4] have been performed. However, the United States Secretary of Health and Human Services, Donna E. Shalala, recently recommended an expansion of the science base to determine the people and populations most at risk for serious oral health conditions; an acceleration of the application of research findings into targeted and effective health prevention methods, and the promotion of their adoption by the public and health professions.[5]

Therefore, the purpose of this study was to investigate the status of a sample of children, 6 to 36 months of age, with regard to prevalence of tooth decay in a community with an optimum fluoridated water supply. It was then determined whether a relation existed between these data and the socioeconomic level of the family.

The hypothesis of this thesis was that there is a correlation between caries prevalence and socioeconomic status in children 6 to 36 months of age.

LITERATURE REVIEW

DENTAL CARIES

Dental caries stem from a quasi-infectious process that takes place when colonies of organisms attach themselves to teeth. These organisms subject the teeth to decalcifying actions, with subsequent cavitation.[6] Dental caries remains the most prevalent disease afflicting humans[7] and has been reported to be the single most common disease of childhood that is not self-limiting or amenable to a course of antibiotics.[8]

Some researchers[7,9] suggest that dental caries incidence has declined in many parts of the industrialized world. In the US, 60 percent of all decay is observed in 20 percent of the population, and almost half of US children aged 5 to 17 years are caries-free.[10]

In contrast, Edelstein and Douglass[8] reported that the 50-percent caries-free statement for US school children is an excessively optimistic representation by the media. Reports in the US regarding caries in preschoolers generally relate to children 3 years of age and older, and data regarding caries experience in preschool-age children, especially in the younger segment of preschoolers, are scant nationally and internationally.[11]

According to Milgrom and Weinstein,[9] much of what we have observed regarding dental caries has not represented the extent of dental caries in the primary dentition, specifically regarding Early Childhood Caries (ECC). Unlike other forms of dental caries, ECC progresses very quickly from white spot lesions or subsurface decalcifications to frank cavitation. The enamel is thin in primary incisors and it is not unusual to see white spot lesions in children younger than 12 months of age.

Unfortunately, older children (4 years and older) are more likely to receive various treatment services (one-surface restorations, two-and-more-surface restorations, pulpal therapy, stainless steel crowns and extractions) than younger children.[12] Dental training programs have been reduced in size, and public health programs have been closed, increasing the risk that inadequate attention will be given to the oral health needs of the most vulnerable children.[9]

In summary, the notion that dental caries is declining may not be true with regard to ECC. Data on ECC are scant, and too few resources are focused on dental caries in children younger than four years of age.

CARIES PREVALENCE IN THE UNITED STATES

It is difficult to determine an accurate national prevalence of ECC.[13,14] According to Ramoz-Gomez et al.,[15] preschool-age children are not readily accessible for examination; examined samples may not be representative; infant feeding practices vary in different cultural and ethnic groups, making extrapolation of findings inappropriate; infants and toddlers often are difficult to examine thoroughly; and criteria for ECC have varied with respect to location of dental decay and number of teeth affected, e.g., any labiolingual lesion in a maxillary incisor, such lesions in two incisors, three carious incisors or a decayed, missing, filled, total number of teeth (DMFT) score of 5 or greater.

Tang et al.[16] examined 5171 children ages 5 months through 4 years in Arizona. They reported a caries prevalence in one-, two-, and three-year-old children of 6.4%, 20%, and 35%, respectively. Nainar and Crall[11] examined 103 records of an inner-city community health center clinic for children ages 5 years and younger in Connecticut

and reported a caries prevalence of 67 percent. Tsubouchi et al.[17] examined 77 Native American infants, 12 to 36 months of age, at the Woman Infant Children (WIC) program at the Tulalip Health Center in Marysville, Washington. They reported a caries prevalence for children aged 12 to 18 months, 18 to 24 months, and 24 to 36 months old of 26.1%, 55.6%, and 55.6%, respectively. This number constituted 41 percent of the children less than 36 months old enrolled on this reservation with non-fluoridated water. Savara and Suher[18] investigated 650 children ages 1 to 6 years living in Portland, Oregon. Children at ages 1 and 2 years had 22.2 percent and 23.1 percent decay, respectively. The caries prevalence increased rapidly to 61.8 percent at 3 years, and the trend continued at a slower rate after that. At 4, 5, and 6 years, the caries prevalence was 70.9%, 78.3%, and 83.8%, respectively. Fulton[19] examined more than 3,000 dental records and reported a caries prevalence of 0%, 7%, and 52% for children aged below 12 months, 12 to 23 months, and 24 to 35 months, respectively.

As part of the Third National Health and Nutrition Examination Survey-Phase 1, an assessment of dental caries in US children was included; and, Kaste et al.[20] reported an ECC prevalence of 0.8 percent for infants aged 12 to 23 months. This finding was representative of national data for the civilian non-institutionalized US population. However, the cursory examination method used may have resulted in an underestimation of caries prevalence.[21]

Lopez Del Valle, Velazquez-Quintana, Weinstein, Domoto, and Leroux[31] reported on an ECC study of 167 Puerto Rican children whose ages ranged from 6 to 47 months (mean = 23 months). The prevalence for frank caries in this study for the ages 6 to 12, 13 to 18, 19 to 24, and 25 to 36 months, were 4.4%, 11.1%, 21.4%, and 26.9%, respectively.

Rule et al.[23] examined 152 African-American children ages 1 to 4 years from Baltimore and Washington D.C. and found a total caries prevalence of 18 percent. Garcia-Godoy, Mobley and Jones[24] investigated 1416 Hispanic children ages 6 months to 5 years in San Antonio, Texas. The overall caries prevalence in these children was 30 percent.

Other studies in the United States specifically examined caries prevalence in known fluoridated water communities. Weddell and Klein[1] surveyed 441 children between the ages of 6 to 36 months and diagnosed dental caries in 2.5 percent of those 6 to 17 months of age, in 9.1 percent of those 18 to 23 months of age, and in 38.7 percent of the children 24 to 36 months of age. Hennon, Stookey and Muhler[25] examined 915 children between 18 and 39 months of age with diagnosed caries in 8.3 percent of the children of ages 18 to 23 months, in 14.6 percent of ages 24 to 27 months, in 33.8 percent of ages 28 to 31 months, and in 45.2 percent of ages 32 to 35 months.

Tank and Storvick[26] compared two Oregon communities, Albany and Corvalis, for the effect of water supply fluoridation upon caries prevalence. The nonfluoridated community of Albany data indicated the percentages of children with caries in the age groups of 1, 2, and 3 years were 11%, 46% and 89%, respectively. The Corvalis data with 1 ppm fluoride added to the community water supply indicated the percentages of children with caries in the age groups of 1, 2, and 3 years were 3%, 21%, and 45%, respectively.

In summary, few studies exist in assessing caries prevalence in the US for children less than 3 years of age. These studies show some indication of caries prevalence within this age group, ranging from as low as 0.8 percent[20] to as high as 89 percent.[26] The national prevalence of ECC has been estimated to be no greater than between 3

percent and 6 percent.[13,27] Caries are known to exist in both fluoridated and non-fluoridated water communities within the US for children younger than 3 years of age and appear to increase in prevalence significantly with age.

CARIES PREVALENCE INTERNATIONALLY

Wendt et al.,[28] Fujiwara et al.,[29] and Holt et al.[4] reported caries to affect 0.5 percent to 2.0 percent of children at approximately 1 year of age, 7.7 percent to 26.3 percent at approximately 2 years of age, and 28.0 percent to 36.6 percent at approximately 3 years of age.

Seow, Amaratunge, Sim, and Wan[30] examined 137 randomly selected healthy infants from 1 to 3.5 years, attending a community health center in Brisbane, a nonfluoridated state capital city of Australia. The caries prevalence was 39 percent by subjects and 32 percent by total number of teeth present. Also in Australia, Halikis[31] investigated 361 children ages 2 to 6 years of age. The prevalence of dental caries was 63.2 percent among the two-year-olds and over 95 percent in the remaining groups.

In Japan, Yonezu and Machida[32] examined 374 children between the ages of 1.5 and 3 years. The caries prevalence at 1.5, 2, and 3 years of age were 6.1%, 14.7%, and 31.8%, respectively. Tsubouchi et al.[33] investigated 100 children in Okayama prefecture, ages 18, 24, and 36 months, and their caries prevalence was 9%, 21%, and 70%, respectively.

In Sweden, Grindefjord, Dahllof and Modeer[34] investigated 692 children ages 2.5 to 3.5 years. At baseline examination, 11.3 percent of the children exhibited dental caries. At follow-up, one year later, decayed surfaces were registered in 36.7 percent of the

subjects. Ninety-two percent of the children who had caries at the baseline developed new carious lesions during the one-year period, compared with 29 percent of the caries free children at baseline. Of the lesions diagnosed at baseline as initial caries, 64 percent progressed to manifest lesions during the one-year period. The study indicated that children with early caries development exhibit high caries progression as well as a high risk for further development of an extensive number of new carious lesions. The high caries progression could have multiple causes, because findings of a high-sugar diet and unsatisfactory oral hygiene were accompanied by the frequent detection of streptococci and lactobacilli colonies. This finding was in accordance with the studies by Kohler et al.[35] and Alaluusua and Renoken,[36] who found that early establishment of mutans streptococci affected the level of caries incidence. Schroder et al.[37] investigated 181 children at 1.5 years and 3 years. Ninety-nine percent of the children were caries-free initially and 28 percent demonstrated caries at age 3.

In summary, international studies also show some indication and various ranges for caries prevalence in children age 3 and younger. Additionally, these studies suggest that dental caries prevalence increased from 6 months to 3 years of age. And, as in the US, limited research has been done in both non-fluoridated and fluoridated water communities internationally for children younger than age 3.

CARIES PREVALENCE AND SOCIOECONOMIC STATUS

Tinanoff, Kaste, and Corbin,[38] stated that ECC is among the most prevalent health problems of low-income infants and toddlers. However, little attention and few resources have been allocated to understanding this disease in these socioeconomic groups. Most of

the US has no caries prevalence data for children 6 years of age and younger,[39] and few dentists are willing to accept Medicaid patients.[40] Typically, Medicaid reimbursement rates for services are outrageously low[39] and dental check-up visits for low-income parents are considered less of a priority than appointments for the relief of pain or other emergencies.[41] In addition, there is a trend for broken or canceled dental appointments ascribed to low-income (Medicaid) recipients.[42,43] Meanwhile, uninsured children are 2.5 times less likely to receive dental care than insured children, and children from families without dental insurance are 3 times more likely to have dental needs as compared with their insured peers.[44] Also, low-income people in the United States work part time. These jobs rarely provide sick leave or accommodations for taking a child to the doctor unless it is an emergency.[9]

Nevertheless, according to Horowitz[21] research is needed to establish a nomenclature and a description of early childhood caries (ECC) that are most relevant to health-care professionals and to the public. Profiles or indices for predicting the prevalence of ECC in communities could be developed on the basis of the socioeconomic factors, immigrant status and ethnic/racial backgrounds of populations.

According to the 1988-94 National Health and Nutrition Examination Survey (NHANES III), Mexican-American and economically disadvantaged children were disproportionately represented with ECC. Yet, the prevalence of ECC among children 12 to 23 months of age was barely detectable at the national level.[20] The NHANES III estimates were consistent with previous projections of the magnitude of ECC in very young children.[14]

In contrast, Tinanoff et al.[44] observed that 80 percent of low-income (Head Start) caries-positive preschool children in Connecticut had unmet dental needs. These findings are in accordance with the observation that higher caries levels are found in minorities and low-income children[45] and is noteworthy, because among minority children, those residing in the New England region have the lowest caries rates in the United States.[46]

Al-Hosani and Rugg-Gunn[2] examined 217 children aged 2, 4 and 5 years from three administrative regions of Abu Dhabi, Al Ain, and Western Region. The caries prevalence for these children was 36 percent to 47 percent. Parents of the children examined also filled out a questionnaire. The children were classified into high, middle and low groups based on their parents' education and income. The parents' education and income were found to be statistically significant related to caries experience ($p < 0.05$). High parental educational attainment was related to lower caries experience. Conversely, high parental income was related to higher caries experience. Infante and Owen[47] investigated 1,155 children, ages 1 to 6 years, representing 36 states and the District of Columbia. The results were divided into four regions and the percentage of one-year-old children with carious lesions ranged from 2.6 percent to 4.8 percent. The two- and three-year-old children had carious lesions ranging from 4.4% to 19.2% and 28.9% to 54.8%, respectively. They also noted that compared with children in the middle socioeconomic group, the lower status children of both urban and rural areas within each geographical region had significantly greater caries experience and significantly lower levels of treatment manifested by the restoration or extraction of teeth.

Wisan, Lafell, and Colwell[48] surveyed 2,677 Philadelphia children between 2 and 5 years of age. They found that 18.4 percent of 200 two-year-old children had caries. By age 3, 52.9 percent had caries. The caries incidence was also less in higher socioeconomic groups than in lower socioeconomic groups. These results supported earlier work by Cohen in 1936.[49] Weddell and Klein,[1] however, noted that caries prevalence was independent of sex, race, and socioeconomic status, although middle and middle-low socioeconomic groups had trends towards higher caries frequencies.

In Camden, England, a series of three similarly designed studies from 1971 to 1988 (Winter et al.,[50] Holt, Joels and Winter,[3] and Holt, Joels, Bulman, and Maddick[4]) were performed correlating caries prevalence and socioeconomic status in preschool aged children attending maternal and child welfare clinics. Caries prevalence decreased from the Winter study in 1971 to the first Holt study in 1982, but the prevalence increased between the 1982 study and Holt's 1988 report. With regard to socioeconomic status based on the father's occupation, the first study demonstrated a statistically significant correlation between caries prevalence and socioeconomic status, whereas the latter two studies[3,4] did not show statistically significant results.

In summary, few resources have been allocated to understanding ECC and its relation to socioeconomic status. Few studies also observe a correlation between caries prevalence and socioeconomic status, specifically for children aged 3 years and younger. In addition, those results are inconsistent or sometimes not significant when comparing caries prevalence and socioeconomic status for children younger than age 3.

SOCIOECONOMIC STATUS

Weddell and Klein[1] used a Two Factor Index of Social Position developed by Hollingshead and Redlich.[51] This index examined two factors, the occupation of the head of the household, and the years of school completed. The index was designed for a specific population sample in New Haven, Connecticut.

Al-Hosani and Rugg-Gunn[2] used parents' education and income to assess socioeconomic levels. Likewise, parents' education and income are the two main variables used by the US Census Bureau[52] when assessing socioeconomic levels in the US.

In summary, to assess socioeconomic status in the past, indexes were used that were specific for the population that were sampled. Sometimes those indexes were used for other studies,[1,53] resulting in less meaningful results. Nonetheless, the US Census doesn't use a specific index to measure socioeconomic status. Instead, the estimated median family household income with a 90-percent confidence interval specific to a population is the main variable currently used when assessing socioeconomic status.[54]

METHODS AND MATERIALS

One hundred fifty children were selected for this study. The children were primarily examined in the pediatric physician offices of the People's Health Center and Dr. Amy Cheng, and at the Baby and Kids Health Fair. The dental office of Dr. James Weddell and the Riley Hospital dental clinics were also utilized. A child's participation was dependent on voluntary commitment by the parent or legal guardian who understood and signed a consent form (Figure 1). A socioeconomic, medical history questionnaire and consent form were completed by the parent or legal guardian (Figure 2). Each child participant's family received a brief consultation, an oral health brochure, and a children's toothbrush. The parents of the children needing dental care were so informed.

SUBJECTS

The criteria for selection of the subjects were as follows:

1. 6 to 36 months of age.
2. Normal, healthy children.
3. Children born and reared in Marion County, Indiana.

EXAMINATIONS

Two examiners, Drs. James Weddell and Brent Ching, reviewed with each other the criteria for identifying dental caries. The criteria for the diagnosis of dental caries was used by The American Dental Association Council on Dental Research,[55] which included changes in the enamel translucency, retention of the explorer point, and softness

at the base of the questionable area. The subjects were either examined on their parent's lap or in a dental chair, while the dental chair assistant recorded the data. A mouth mirror, explorer, and portable light were used. The data were recorded on a diagnostic sheet (Figure 3).

EXAMINATION OF TEETH

Starting on the right, each maxillary tooth was thoroughly examined. Then dropping to the lower left, each mandibular tooth was also examined. The teeth were scored on all five surfaces: 1- occlusal or incisal, 2 - buccal or labial, 3 - distal, 4 – lingual, and 5 - mesial. All erupted tooth surfaces were recorded as: S - sound, A - incipient caries, and B - frank caries. Unless sound or carious, each tooth will be recorded as: U - unerupted, X - missing if extracted due to dental caries, F - restored, and N - non-applicable, hypoplastic, hypocalcified, fractured.

SOCIOECONOMIC EVALUATION

An effort was made to select the most current household income data from the US Census Bureau for Marion County, Indiana. From the data gathered on the socioeconomic questionnaire (Figure 2), four income ranges were used: $0-19,999, $20,000-39,999, $40-59,999 and > $60,000. These income ranges were labeled into four groups: low, median, upper median and upper, respectively. Those groups were based on the US Census Bureau's report for Marion County's 1995 median income level, which was estimated to be $33,695 with a 90-percent confidence interval.[54]

STATISTICAL METHODS

The number of surfaces at risk (SAR) was defined to be the total number of decayed, filled, missing, and sound surfaces. The child was defined to have caries if any surfaces were decayed, filled, or missing.

Bivariate relation between caries status and demographic variables were examined using chi-square tests for categorical variables and logistic regression for continuous variables. Multivariate prediction of caries status was performed using logistic regression.

Bivariate relations between the number of decayed surfaces, missing surfaces if teeth were extracted due to dental caries, filled surfaces, total erupted surfaces (DMFS) or total erupted teeth (DMFT), and categorical demographic variables were examined using analysis of covariance, adjusting for the number of surfaces at risk. Because age is highly correlated with the number of surfaces at risk, the inclusion of both SAR and age in the same model interferes with the interpretation of the model. Therefore, the bivariate relation between DMFS or DMFT and age was examined using a Pearson correlation coefficient (p value), not adjusted for SAR. A p value equal to or less than 0.05 was considered statistically significant. A p value greater than 0.05 to 0.10 was considered marginally statistically significant. A p value greater than 0.10 was considered not statistically significant. Multivariate prediction of DMFS and DMFT was performed using analysis of variance, with no adjustment for the number of surfaces at risk, because age was included in the models.

RESULTS

Primary analyses were performed for 150 children who met the subject criteria (Table I and Appendix I). One-hundred twenty-two children were known to be drinking from Marion County's optimum fluoridated city water supply, whereas 28 children received bottled or other water. All 150 children fell into the following age groups and numbers: 6 to 12 months, 24 children; 13 to 28 months, 30 children; 19 to 24 months, 23 children; 25 to 30 months, 31 children; and 31 to 36 months, 42 children. No surfaces were missing or filled, so that only the number of decayed surfaces and total surfaces at risk were reported (Appendix I).

In Table II (bivariate relation between caries status and demographic variables), mother's education was collapsed into two categories: no high school + high school, and college + post-college. Father's education was collapsed into three categories: no high school + high school, college, and post-college. Income was collapsed into four categories: $0 – $20000, $20000 – $40000, $40000 – $60000, and $60000+.

For all 150 children, the following age groups experienced these incidences of caries:

Ages 6 to 12 months, 4.0%.

Ages 13 to 18 months, 0%.

Ages 19 to 24 months, 22%.

Ages 25 to 30 months, 23%.

Ages 31 to 36 months, 26%.

A marginally lower percentage of females than males had caries ($p = 0.07$).

The percentage of children with caries increased with age ($p = 0.01$).

A lower percentage of children whose mother had college or post-college education had caries ($p = 0.01$). A marginally higher percentage of children whose father had high school or less education had caries ($p = 0.09$).

A marginally higher percentage of children whose family had low income ($0-20K) had caries ($p = 0.07$). A higher percentage of children with Medicaid had caries ($p = 0.04$).

A marginally larger percentage of children from single parents had caries ($p = 0.08$).

For the 122 children known to have fluoridated water, being male or female was not related to caries ($p = 0.21$). The percentage of children with caries increased with age ($p = 0.01$). A smaller percentage of children whose mother had college or post-college education had caries ($p = 0.04$). Father's education and income were not related to caries ($p = 0.17$ and 0.15, respectively). A higher percentage of children with Medicaid had caries ($p = 0.02$). A marginally higher percentage of children from single parents had caries ($p = 0.08$). Use of city water was not significantly related to caries status ($p = 0.77$).

In the multivariate analyses of caries status (Table III), only age remained significant as a predictor of caries status: the odds of caries were 1.1 times for each monthly increase in age ($p = 0.03$ for children with known fluoride status, and $p = 0.01$ for all 150 children). Father's education was not used in the multivariate analyses, because of a large percentage of unavailable data.

Tables IV and V (bivariate relation with DMFS: all 150 children and fluoridated water, respectively), indicate that age had a marginally significant positive relation with DMFS, i.e., as age increased, DMFS increased ($p = 0.06$). This relation was not significant for those children known to have fluoridated water ($p = 0.43$). For all 150 children, children whose mother had college or post-college education had significantly higher DMFS ($p = 0.05$); this relation was marginally significant for those children known to have fluoridated water ($p = 0.09$). For the 122 children known to have fluoridated water, children with Medicaid had significantly higher DMFS than children without Medicaid ($p = 0.05$); this relation was not significant using all 150 children ($p = 0.19$). Gender, father's education, income, use of city water, and single parents were not significantly related to DMFS.

In Table VI (multivariate prediction of DMFS), no significant multivariate predictors of DMFS were found.

In Tables VII and VIII (bivariate relation with DMFT: all 150 children and fluoridated water, respectively), children who used city water had significantly lower DMFT ($p = 0.04$). For all 150 children, age had a significant positive relation with DMFT, i.e., as age increased, DMFT increased ($p < 0.05$); this relation was not significant using only those children known to have fluoridated water ($p = 0.28$). Children whose mother had college or post-college education had significantly lower DMFT than children whose mother did not have college education ($p = 0.04$ for children with known fluoride status, and $p = 0.02$ for all children). For those children known to have fluoridated water, children with Medicaid had significantly higher DMFT than children without Medicaid ($p = 0.03$); this relation was not significant using all children

($p = 0.29$). Gender, father's education, income, and single parents were not significantly related to DMFT.

In Table IX (multivariate prediction of DMFT, using all 150 children), age had a significant positive relation with DMFT ($p = 0.02$); females had marginally lower DMFT ($p = 0.08$); children whose mother did not have college education had marginally lower DMFT ($p = 0.05$), and children who used city water had marginally lower DMFT ($p = 0.08$). However income, Medicaid, and single parents were not significantly related to DMFT. Using only those children known to have fluoridated water, no significant multivariate predictors of DMFT were found.

FIGURES AND TABLES

FIGURE 1. Consent letter.

IUSD Informed Consent Statement for: Research Project on Correlation between Caries Prevalence and Socioeconomic Status in 6 to 36 Month Old Children

Dear Parents:

20 years ago an early childhood cavities study was conducted to determine the dental health status of children up to three years of age throughout Marion County, Indiana. The results of this study have been useful to various agencies in identifying the dental needs and appropriate preventive programs for our children.

The Indiana University School of Dentistry's Pediatric Dental Program with the approval of local officials is once again undertaking an early childhood cavities study of children residing in selected communities of Indiana. The purpose of this study is to assess the success of our past preventive programs as well as to evaluate the status of a sample of children with regards to current prevalence of tooth decay. As part of the investigation we would like to collect information regarding socioeconomic patterns and would like to invite you and your children to participate.

The study will be initiated in the Fall of 1999 (through June of 2000) and will include approximately 300 children. A dentist from the Indiana University School of Dentistry's Pediatric Dental Program will perform a thorough dental examination of the teeth, gums and other hard and soft tissues in the mouth. It is anticipated the examination will take about 10-15 minutes. The examinations will be conducted using standard sterilized dental instruments, portable dental equipment and protective disposable gloves, gowns and eyewear. The exam will be by touch and sight only and will not include the use of x-rays.

To be eligible to participate, each child's parent must return this completed informed consent letter to the study's examiner. Benefits which your child will receive will include a thorough dental examination, a toothbrush, and oral health educational brochures when appropriate. Also, an advisory letter outlining the oral health needs of those found to be in obvious need of dental treatment will be sent to the parents or guardian. Participants will not receive any payment for participation in this study. In the event of physical injury resulting from your participation in this research, necessary medical treatment will be provided to you and billed as part of your medical expenses. Costs not covered by your health care insurer will be your responsibility. Also, it is your responsibility to determine the extent of your health care coverage. There is no program in place for other monetary compensation for such injuries. However, you are not giving up any legal rights or benefits to which you are otherwise entitled.

We emphasize that this study does not involve restorative dental treatment (fillings) and we encourage you to continue your child's regular visits to his/her dentist. It should also be noted that participation is strictly voluntary and you may withdraw you child for any reason. Leaving the study will not result in any penalty of loss of benefits to which you are entitled. While the general results of this study may be published at the end, you are assured that none of the participants, records, intraoral photographs if taken, will be identified personally. Also, all individual socioeconomic data will be kept confidential.

If you have any questions, or wish more information, please feel free to call Drs. James Weddell and/or Brent Ching, at (317) 274-8492 or the Indiana University School of Dentistry at 274-7957. A patient representative who is not associated with this research to whom we may address complaints about this study, as well as questions about my child's right as a research participant, may be reached at 274-6637. Thank you very much for your help with this project.

If you are willing for your child to participate in this study, please complete the back page of this form and return it to your study examiner.

Sincerely,

James A. Weddell, D.D.S. M.S.D.
Associate Professor of Pediatric Dentistry

FIGURE 2. Information questionnaire.

PLEASE PRINT FIRMLY WITH A BALL POINT PEN!
ALL QUESTIONS MUST BE ANSWERED & SIGNATURES PROVIDED

CHILD'S NAME_____SEX_____DATE OF BIRTH ___/___/___
Mo / D / Yr

ADDRESS_____CITY_____ZIP_____

Does your child drink from city water? YES_____ NO_____ Well water? YES_____ NO_____

Has your child ever had any history of the following? (if yes, please check)

____Heart trouble	____Allergies	____Kidney or Liver Disease
____Asthma	____Epilepsy	____Diabetes
____Anemia	____Nervousness	____Rheumatic Fever
____Hepatitis	____Tuberculosis	____Bleeding Disorders

Has your child ever been hospitalized or had a serious illness? YES_____ NO_____
If yes, please explain: _____

THE FOLLOWING SOCIOECONOMIC/DEMOGRAPHIC INFORMATION
WILL BE KEPT CONFIDENTIAL

Does your child have and brothers or sisters? YES_____ NO_____ How many? _____

Are you currently: Single_____ Married_____

What is the educational level of child's parents? (Please use M for Mother, F for Father)

8 years or less	_____	9 – 12 years	_____
13 – 16 years	_____	Post College	_____

Is anyone in your household employed? YES_____ NO_____ Who? _____

Which of the following represents yearly income: (please check one in each column)

			YOUR FAMILY'S
0-$9,999	_____	_____	_____
10,000-$19,999	_____	_____	_____
20,000-$39,999	_____	_____	_____
40,000-$59,999	_____	_____	_____
60,000-$100,000	_____	_____	_____
Greater than $100,000	_____	_____	_____
Not applicable	_____	_____	_____

Are you presently enrolled (or eligible) for Medicaid? YES_____ NO_____ DON'T KNOW_____

Do you presently have dental insurance? YES_____ NO_____

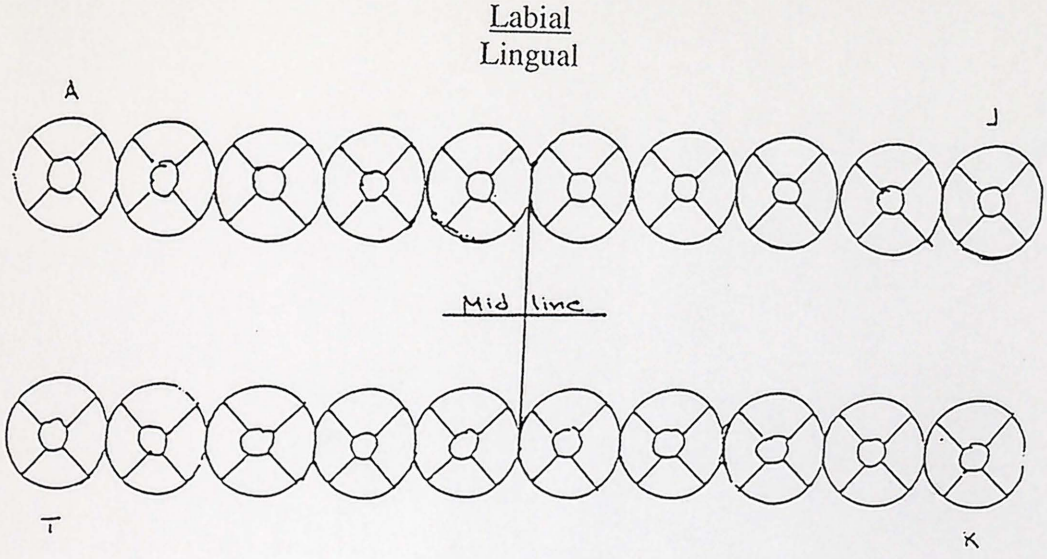
I have read the description of the dental study and wish my child to participate in the program.
I understand that participation is voluntary and that my child is free to withdraw at any time.

CHILD'S NAME_____

PARENT'S (Guardian's) SIGNATURE_____DATE_____

FIGURE 3. Caries record sheet.

Dental Chart



Dental Chart Legend from Protocol

S – sound
A – incipient dental caries
B – frank dental caries

U – unerupted
X – missing if extracted due to dental caries
F – restored
N – non-applicable, hypoplastic, hypocalcified, fractured

FIGURE 4. Advisory letter.

INDIANA UNIVERSITY

SCHOOL OF DENTISTRY

Dear Parent:

Thank you for allowing your child to participate in this Indiana University research project. Your cooperation helps to identify the dental needs and appropriate preventive programs for Indiana children.

This survey examination is not intended to replace a complete examination by your family dentist (which might include x-rays). If your child is receiving regular checkups, your family dentist may already be aware of the following:

____ No obvious problems - regular dental checkups recommended

____ Questionable area(s) on teeth which should be examined by a dentist in the near future, or at your child's next checkup.

____ Oral condition needing care by a dentist. Please make an appointment as soon as possible.

____ Better daily brushing is recommended.

You are encouraged to make appointments for your child with a dentist for regular checkups. While visiting your dentist, don't forget to ask about sealants to prevent cavities.

Sincerely,

James A. Weddell, D.D.S., M.S.D.
Project Director

Brent B.Y. Ching, D.D.S.
Co-Investigator

DEPARTMENT OF
ORAL FACIAL DEVELOPMENT

PEDIATRIC DENTISTRY SECTION

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Located on the campus of
Indiana University
Purdue University
Indianapolis

TABLE I
Primary analysis of demographic variables

		Fluoridated Water		All Children	
		#	%	#	%
Gender	Female	52	43	69	46
	Male	70	57	81	54
Age (months)	6 – 12	16	13	24	16
	13 – 18	23	19	30	20
	19 – 24	18	15	23	15
	25 – 30	26	21	31	21
	31 – 36	39	32	42	28
Caries	No	102	84	126	84
	Yes	20	16	24	16
Mother's Education	No H.S.	0	0	1	1
	H.S.	50	44	56	41
	College	47	42	63	46
	Post-College	16	14	18	13
Father's Education	No H.S.	2	3	2	2
	H.S.	33	46	38	44
	College	22	31	27	31
	Post-College	15	21	19	22
Income ($1000)	0 – 20	39	35	42	31
	20 – 40	26	23	33	24
	40 – 60	18	16	23	17
	60 – 100	19	17	26	19
	100+	9	8	12	9
City Water	Unknown Fluoride Status	0	0	28	19
	Yes	122	100	122	81
Medicaid	No	76	63	99	68
	Yes	44	37	47	32
Single Parent	No	62	53	80	53
	Yes	56	47	64	44

TABLE II

Bivariate relation between caries status and demographic variables

		Fluoridated Water			All Children		
		#	%	p	#	%	p
Total		20	16		24	16	
Gender	Female	6	12	0.21	7	10	0.07
	Male	14	20		17	21	
Age (months)	6 – 12	1	6	0.01	1	4	0.01
	13 – 18	0	0		0	0	
	19 – 24	4	22		5	22	
	25 – 30	6	23		7	23	
	31 – 36	9	23		11	26	
Mother's Education	No H.S.+H.S.	13	26	0.04	16	28	0.01
	College+P.C.	7	11		8	10	
Father's Education	No H.S.+H.S.	8	22	0.17	10	25	0.09
	College	1	5		2	7	
	Post-College	2	13		2	11	
Income ($1000)	0 – 20	10	26	0.15	11	26	0.07
	20 – 40	2	8		4	12	
	40 – 60	3	17		3	13	
	60+	3	11		4	11	
City Water	Unknown Fluoride Status				4	14	0.77
	Yes	20	17		20	17	
Medicaid	No	8	11	0.02	12	12	0.04
	Yes	12	27		12	26	
Single Parent	No	7	11	0.08	9	11	0.08
	Yes	13	23		14	22	

TABLE III

Multivariate prediction of caries status

		p	Odds Ratio	
Fluoridated Water	Age (months)	0.03	1.1	
	Gender	0.28	0.5	F vs. M
	Mother's Education	0.26	2.4	No College vs. College
	Income	0.62	1.5	Low vs. High
			0.4	Median vs. High
			1.3	Upper Median vs. High
	Medicaid	0.26	0.4	No vs. Yes
	Single Parent	0.47	18	No vs. Yes
All Children	Age (months)	0.01	1.1	
	Gender	0.13	0.4	F vs. M
	Mother's Education	0.14	2.8	No College vs. College
	Income	0.82	1.8	Low vs. High
			0.9	Median vs. High
			1.0	Upper Median vs. High
	City Water	0.68	1.4	Unknown vs. Yes
	Medicaid	0.45	0.6	No vs. Yes
	Single Parent	0.53	1.6	No vs. Yes

TABLE IV

Bivariate relation with DMFS: all 150 children*

		N	Mean	SD	SE	Min	Max	p
Gender	Female	69	1.3	5.8	0.7	0.0	37.0	0.39
	Male	81	2.6	7.9	0.9	0.0	47.0	
Mother's Education	No H.S.+H.S.	57	4.1	9.7	1.3	0.0	47.0	0.05
	College+P.C.	81	0.9	4.5	0.5	0.0	37.0	
Father's Education	No H.S.+H.S.	40	3.1	9.6	1.5	0.0	47.0	0.14
	College	27	0.3	1.4	0.3	0.0	7.0	
	Post-College	19	2.8	9.1	2.1	0.0	37.0	
Income ($1000)	0 – 20	42	3.4	9.7	1.5	0.0	47.0	0.51
	20 – 40	33	1.3	4.7	0.8	0.0	24.0	
	40 – 60	23	0.2	0.7	0.1	0.0	3.0	
	60+	38	1.6	6.5	1.1	0.0	37.0	
City Water	Unknown Fluoride Status	28	2.5	7.5	1.4	0.0	32.0	0.17
	Yes	122	1.9	7.0	0.6	0.0	47.0	
Medicaid	No	99	1.4	5.8	0.6	0.0	37.0	0.19
	Yes	47	3.4	9.2	1.3	0.0	47.0	
Single Parent	No	80	1.3	5.7	0.6	0.0	37.0	0.52
	Yes	64	3.0	8.5	1.1	0.0	47.0	

*Correlation between DMFS and age: 0.15 (marginally significant at $p = 0.06$).

TABLE V

Bivariate relation with DMFS: fluoridated water*

		N	Mean	SD	SE	Min	Max	p
Gender	Female	52	1.3	5.9	0.8	0.0	37.0	0.47
	Male	70	2.4	7.6	0.9	0.0	47.0	
Mother's Education	No H.S.+H.S.	50	3.4	9.1	1.3	0.0	47.0	0.09
	College+P.C.	63	1.0	5.1	0.6	0.0	37.0	
Father's Education	No H.S.+H.S.	35	2.4	8.9	1.5	0.0	47.0	0.14
	College	22	0.1	0.4	0.1	0.0	2.0	
	Post-College	15	3.5	10.1	2.6	0.0	37.0	
Income ($1000)	0 – 20	39	2.9	8.9	1.4	0.0	47.0	0.57
	20 – 40	26	0.5	2.4	0.5	0.0	12.0	
	40 – 60	18	0.3	0.8	0.2	0.0	3.0	
	60+	28	2.0	7.5	1.4	0.0	37.0	
City Water	Yes	122	1.9	7.0	0.6	0.0	47.0	
Medicaid	No	76	1.0	4.8	0.4	0.0	37.0	0.05
	Yes	44	3.6	9.5	1.4	0.0	47.0	
Single Parent	No	62	1.1	5.1	0.7	0.0	37.0	0.36
	Yes	56	3.0	8.6	1.1	0.0	47.0	

*Correlation between DMFS and age: 0.07 (non-significant $p = 0.43$).

TABLE VI

Multivariate prediction of DMFS

		p
Fluoridated Water	Age (months)	0.65
	Gender	0.41
	Mother's Education	0.33
	Income	0.54
	Medicaid	0.50
	Single Parent	0.97
All Children	Age (months)	0.11
	Gender	0.24
	Mother's Education	0.12
	Income	0.55
	City Water	0.21
	Medicaid	0.94
	Single Parent	0.88

TABLE VII

Bivariate relation with DMFT: all 150 children*

		N	Mean	SD	SE	Min	Max	p
Gender	Female	69	0.5	1.9	0.2	0.0	11.0	0.13
	Male	81	1.2	2.9	0.3	0.0	14.0	
Mother's Education	No H.S.+H.S.	57	1.7	3.5	0.5	0.0	14.0	0.02
	College+P.C.	81	0.4	1.6	0.2	0.0	11.0	
Father's Education	No H.S.+H.S.	40	1.3	3.2	0.5	0.0	14.0	0.11
	College	27	0.3	1.2	0.2	0.0	6.0	
	Post-College	19	0.9	2.9	0.7	0.0	11.0	
Income ($1000)	0 – 20	42	1.4	3.3	0.5	0.0	14.0	0.50
	20 – 40	33	0.7	2.2	0.4	0.0	10.0	
	40 – 60	23	0.2	0.7	0.1	0.0	3.0	
	60+	38	0.7	2.3	0.4	0.0	11.0	
City Water	Unknown Fluoride Status	28	1.3	3.4	0.6	0.0	14.0	0.04
	Yes	122	0.8	2.3	0.2	0.0	12.0	
Medicaid	No	99	0.7	2.4	0.2	0.0	14.0	0.29
	Yes	44	1.3	2.9	0.4	0.0	12.0	
Single Parent	No	80	0.6	2.3	0.3	0.0	14.0	0.60
	Yes	64	1.2	2.8	0.4	0.0	12.0	

*Correlation between DMFT and age: 0.19 (significant at $p < 0.05$).

TABLE VIII

Bivariate relation with DMFT: fluoridated water*

		N	Mean	SD	SE	Min	Max	p
Gender	Female	52	0.4	1.7	0.2	0.0	11.0	0.20
	Male	70	1.0	2.6	0.3	0.0	12.0	
Mother's Education	No H.S.+H.S.	50	1.3	2.9	0.4	0.0	12.0	0.04
	College+P.C.	63	0.4	1.7	0.2	0.0	11.0	
Father's Education	No H.S.+H.S.	35	0.9	2.6	0.4	0.0	12.0	0.10
	College	22	0.1	0.4	0.1	0.0	2.0	
	Post-College	15	1.2	3.3	0.8	0.0	11.0	
Income ($1000)	0 – 20	39	1.2	2.7	0.4	0.0	12.0	0.50
	20 – 40	26	0.3	1.4	0.3	0.0	7.0	
	40 – 60	18	0.3	0.8	0.2	0.0	3.0	
	60+	28	0.7	2.5	0.5	0.0	11.0	
City Water	Yes	122	0.8	2.3	0.2	0.0	12.0	
Medicaid	No	76	0.4	1.7	0.2	0.0	11.0	0.03
	Yes	44	1.4	3.0	0.4	0.0	12.0	
Single Parent	No	62	0.5	1.8	0.2	0.0	11.0	0.30
	Yes	56	1.1	2.7	0.4	0.0	12.0	

*Correlation between DMFT and age: 0.10 (non-significant p = 0.28).

TABLE IX

Multivariate prediction of DMFT

		P
Fluoridated Water	Age (months)	0.37
	Gender	0.19
	Mother's Education	0.21
	Income	0.64
	Medicaid	0.55
	Single Parent	0.77
All Children	Age (months)	0.02
	Gender	0.08
	Mother's Education	0.05
	Income	0.53
	City Water	0.08
	Medicaid	0.72
	Single Parent	0.63

DISCUSSION

The findings in this study show caries experience comparable with those of previous caries prevalence studies nationally and internationally (Appendix II). Compared with other caries prevalence studies in Indiana, Hennon et al.[24] and Weddell and Klein[1] demonstrate lower caries experience between ages 18 to 27 months and a higher caries experience for ages 30 to 36 months.

A reason for the higher caries prevalence in this study may be due to a higher proportion of patients in the 18-to-27 month age range examined in a dental office setting. Many of these patients seen in a dental office setting were actively seeking dental care because of abnormal appearance or pain associated with carious teeth; therefore, the sample population was biased by the presence of recognizable pre-existing carious lesions.[14]

As for the children, aged 30 to 36 months, a greater proportion of these patients in this study were examined at pediatrician offices or at the Baby and Kids Health Fair without a radiographic survey. In contrast, Weddell and Klein[1] and Hennon et al.[24] used radiographs to detect caries when a full complement of primary teeth and patient compliance was available. According to Hennon et al.,[24] 75 percent of dental caries goes undetected without the use of radiographs. Therefore, this study resulted in a lower caries experience for children aged 30 to 36 months.

The findings in this study also serve as a resourceful comparison to the similar study by Weddell and Klein.[1] Weddell and Klein determined their population sample to

be close to representative of Marion County by using Hollinghead's Two Factor Index of Social Position. Weddell and Klein also concluded that caries prevalence increased with age and was independent of gender and socioeconomic status.

In this study, similar to the most recent study[2] examining caries prevalence and socioeconomic status for children in the age range of 6 to 36 months, family household income and level of parental education attainment were two variables used to assess the socioeconomic level of the population sample, rather than Hollingshead's Two Factor Index of Social Position. Coincidentally, our population sample was also close to being representative of Marion County.

In Appendix III, family household income was broken down into several ranges for Marion County, Indiana.[52] The US Census Bureau reported that the median household income level of Marion County in 1995 was $33,695 with a 90-percent confidence interval.[54] Dividing the household income levels in this study into the following cells, lower median ($0 to 20,000), median ($20,000 to 40,000), upper median ($40,000 to 60,000) and upper (> $60,000), and comparing those cells with the ranges in Appendix III, the patient sample distribution of Table I fell within a +/- 10 percent range. Therefore, based on family household income, the patient sample distribution in this study was considered close to being representative of Marion County.

In this study, caries prevalence also increased with age; however, for all 150 children, a marginally lower percentage of females than males had caries (Table II, $p = 0.07$). Also, with regards to the socioeconomic variables used in this study, a marginally higher percentage of children whose family had below median income ($0-20K) had

caries (Table II, $p = 0.07$), a lower percentage of children whose mother had college or post-college education had caries (Table II, $p = 0.01$), and a marginally higher percentage of children whose father had high school or less education had caries (Table II, $p = 0.09$).

Appendix IV lists several studies with inconsistent correlation results between caries prevalence and socioeconomic status. Al-Hosani and Rugg-Gunn[2] demonstrate statistically significant results between caries prevalence and the socioeconomic variables, household income and parental education attainment. However, the relation between caries prevalence and income[2] was inconsistent with this study with regard to income. Al-Hosani and Rugg-Gunn demonstrated high parental income related to higher caries experience.

In contrast, Winter[50] and Wisan et al.[48] demonstrate statistically significant results similar to this study. These studies demonstrated a higher caries experience in lower socioeconomic groups and less caries experience in higher socioeconomic groups.

Meanwhile, other studies, such as Weddell and Klein[1] and two of three similar studies in England,[3,4] demonstrate no significant correlation between caries prevalence and socioeconomic status. However, Weddell and Klein did notice that middle and middle-low socioeconomic groups had trends towards higher caries frequencies.

It is important to note that inconsistencies with this study to other studies may be due to several additional factors. The data in this study could have been strongly influenced by our small sample size ($n = 150$) and the inter-examiner variability of dental caries diagnosis and evaluation of socioeconomic status. Other factors that could have

contributed to inconsistencies among these studies include age,[1,14] fluoridated water supply,[1,25] urban environment, dental I.Q. of the parent and child,[1,50]and diet.[1,14,17]

Therefore, if this investigation were to be repeated or expanded in the future, I would recommend an increase in sample size, one examiner to perform all the dental exams, and an exclusion of patient data obtained in a dental office. Those recommendations would decrease certain biases and offer more meaningful results.

SUMMARY AND CONCLUSIONS

A study of 150 children between the ages of 6 and 36 months, born and reared in a community with an optimum fluoridated water supply, revealed a caries prevalence for the following age groups:

4%, ages 6 to 12 months.

0%, ages 13 to 18 months.

22%, ages 19 to 24 months.

23%, ages 25 to 30 months.

26%, ages 31 to 36 months.

Regarding caries data in children 6 months to 36 months of age in this study, the following conclusions can be made:

(1) Caries prevalence increases with age, and the number of decayed surfaces is higher than the number of decayed teeth.

(2) Caries prevalence is lower in children whose mother had college or post-college education.

(3) Caries prevalence was higher in children with Medicaid.

(4) Caries prevalence is marginally lower in females than in males.

(5) Caries prevalence is marginally higher in children whose father had high school or less education.

(6) Caries prevalence is marginally higher for children whose family had low-income ($0-20,000).

(7) Caries prevalence is marginally higher in children with single parents.

From these conclusions, the hypothesis of this thesis is accepted. With regards to Medicaid, low-income ($0-20K), mother's education attainment, and father's education attainment, there is a correlation between caries prevalence and socioeconomic status. Unfortunately, caries prevalence research in correlation with socioeconomic status for children in the age range of 6 to 36 months is limited with inconsistent results and is needed nationally and internationally to aid in the development of future preventive oral health programs. Parents, dentists, and other health care professionals involved with the care of young children need to be more aware of their dental needs and the necessity for much earlier treatment for the prevention of dental disease. Based on the findings of this study, caries prevention in children should be addressed as early as 6 months of age.

These conclusions reiterate those made by prominent health care professionals referenced in this thesis, including Drs. Crall,[11,44] Domoto,[17,31,33] Horowitz,[39] Tinanoff,[13,16,38,44] and Weinstein,[31,40] who are devoted to the establishment of evidence-based programs for the eradication of dental caries in children as young as 6 to 36 months of age. Their conclusions were addressed with other health care professionals, such as Donna Shalala, Secretary of the United States Department of Health and Human Services. Together, they aided in the development of the first-ever Surgeon General's Report, a promising and positive step for infant and children oral health.

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APPENDIXES

APPENDIX I

Raw data: ages 6 to 12 mos.

Patient Number	Gender	Age in mo	D	M	F	S	T	EDU in Yrs Mother/ Father	FAMILY INCOME by K ($1000)	City Water
1	m	6	0	0	0	10	0	9 to 12/ 9 to 12	20 to 40	y
2	m	6	0	0	0	5	0	9 to 12/ 9 to 12	0 to 20	y
3	m	7	0	0	0	10	0	Col / 9 to 12	20 to 40	y
4	f	7	0	0	0	10	0	Col / 9 to 12	20 to 40	y
5	f	9	0	0	0	25	0	9 to 12/ 9 to 12	20 to 40	y
6	f	9	0	0	0	10	0	PostCol/	40 to 60	y
7	m	10	0	0	0	25	0	9 to 12/ 9 to 12	20 to 40	y
8	m	10	0	0	0	0	0	PostCol/		y
9	m	11	0	0	0	30	0	Col /	> 100	y
10	f	11	0	0	0	10	0	9 to 12/ 9 to 12	20 to 40	y
11	f	11	0	0	0	20	0			y
12	m	11	0	0	0	25	0	PostCol/ Pcol	> 100	y
13	m	11	7	0	0	40	6	9 to 12/ 9 to 12	0 to 20	y
14	m	12	0	0	0	50	0	9 to 12/	0 to 20	y
15	f	12	0	0	0	25	0	Col /Post Col	60 to 100	y
16	f	12	0	0	0	40	0	9 to 12/ 9 to 12	0 to 20	y

(continued)

APPENDIX I (cont.)

Raw data: ages 13 to 18 mos.

Patient Number	Gender	Age in mo	D	M	F	S	T	EDU in Yrs Mother/Father	FAMILY INCOME by K ($1000)	City Water
17	m	13	0	0	0	30	0	9 to 12/ 9 to 12	0 to 20	y
18	m	13	0	0	0	30	0	PostCol/		y
19	f	13	0	0	0	40	0	Col / Col	20 to 40	y
20	m	13	0	0	0	60	0	Col / Col		y
21	m	13	0	0	0	40	0	Col / 9 to 12	40 to 60	y
22	f	14	0	0	0	80	0		0 to 20	y
23	f	14	0	0	0	35	0	PostCol/		y
24	m	14	0	0	0	45	0	PostCol/ Pcol	> 100	y
25	m	15	0	0	0	40	0	Col /	0 to 20	y
26	f	15	0	0	0	60	0	9 to 12/	40 to 60	y
27	m	15	0	0	0	40	0	Col / Col	40 to 60	y
28	f	15	0	0	0	35	0	9 to 12/ 9 to 12	0 to 20	y
29	m	16	0	0	0	80	0	Col / Col	> 100	y
30	m	16	0	0	0	50	0	Post Col/ Pcol	60 to 100	y
31	f	16	0	0	0	65	0	9 to 12/	40 to 60	y
32	f	17	0	0	0	80	0	Col / 9 to 12	20 to 40	y
33	f	17	0	0	0	50	0	Col /	60 to 100	y
34	m	17	0	0	0	70	0	Col / 9 to 12		y
35	m	17	0	0	0	100	0	9 to 12/	0 to 20	y
36	m	17	0	0	0	60	0	Col / 9 to 12	0 to 20	y
37	m	18	0	0	0	80	0	Col / 9 to 12	40 to 60	y
38	m	18	0	0	0	80	0	9 to 12/ Col		y
39	m	18	0	0	0	40	0	Col / Pcol	> 100	y

(continued)

APPENDIX I (cont.)

Raw data: ages 19 to 24 mos.

Patient Number	Gender	Age in mo	D	M	F	S	T	EDU in Yrs Mother/Father	FAMILY INCOME by K ($1000)	City Water
40	m	19	25	0	0	60	8	9 to 12/ 9 to 12	0 to 20	y
41	m	19	0	0	0	90	0	9 to 12/	0 to 20	y
42	f	19	0	0	0	45	0	Col /	40 to 60	y
43	f	20	0	0	0	60	0	9 to 12/ Col	20 to 40	y
44	m	20	1	0	0	70	1	9 to 12/ 9 to 12	0 to 20	y
45	m	20	0	0	0	70	0	9 to 12/	0 to 20	y
46	m	20	0	0	0	80	0	9 to 12/	0 to 20	y
47	f	21	0	0	0	60	0	Col /Col	60 to 100	y
48	f	21	0	0	0	80	0	Col / 9 to 12	20 to 40	y
49	m	22	0	0	0	95	0	Col /	20 to 40	y
50	m	22	0	0	0	80	0	Col / 9 to 12	40 to 60	y
51	m	22	0	0	0	80	0	Post Col/ Pcol	> 100	y
52	m	22	19	0	0	80	6	9 to 12/	0 to 20	y
53	f	23	37	0	0	100	11	Post Col/ Pcol	60 to 100	y
54	m	23	0	0	0	100	0	9 to 12/	0 to 20	y
55	f	23	0	0	0	100	0	Post Col/ Col	60 to 100	y
56	m	24	0	0	0	70	0	Col / Pcol	60 to 100	y
57	m	24	0	0	0	80	0	Col / Col	0 to 20	y

(continued)

APPENDIX I (cont.)

Raw data: ages 25 to 30 mos.

Patient Number	Gender	Age in mo	D	M	F	S	T	EDU in Yrs Mother/Father	FAMILY INCOME by K ($1000)	City Water
58	m	25	0	0	0	100	0	Col / Col	20 to 40	y
59	m	25	0	0	0	90	0	/ 9 to 12	20 to 40	y
60	m	25	0	0	0	100	0		0 to 20	y
61	f	25	0	0	0	80	0	9 to 12/	20 to 40	y
62	m	25	1	0	0	100	1	Pcol / 9 to 12	40 to 60	y
63	f	25	1	0	0	100	1	Col /	0 to 20	y
64	m	26	0	0	0	100	0	/ Pcol	40 to 60	y
65	f	26	0	0	0	80	0	Pcol / Col	60 to 100	y
66	m	26	0	0	0	80	0	9 to 12/ 9 to 12	20 to 40	y
67	m	26	0	0	0	100	0	Pcol / Col	60 to 100	y
68	f	26	0	0	0	95	0	9 to 12/	0 to 20	y
69	f	26	0	0	0	80	0	9 to 12/ 9 to 12	20 to 40	y
70	f	26	0	0	0	90	0	Col /	60 to 100	y
71	m	27	26	0	0	100	10	9 to 12/	0 to 20	y
72	m	27	0	0	0	80	0	9 to 12/	0 to 20	y
73	m	27	0	0	0	100	0	Col / <8	0 to 20	y
74	m	28	0	0	0	100	0	9 to 12/	0 to 20	y
75	f	28	0	0	0	80	0	Col /	0 to 20	y
76	f	29	2	0	0	80	1	Col /	60 to 100	y
77	f	29	0	0	0	20	0	9 to 12/	0 to 20	y
78	m	29	12	0	0	100	7	9 to 12/	20 to 40	y
79	f	29	0	0	0	80	0	9 to 12/	20 to 40	y
80	f	29	0	0	0	100	0	9 to 12/ 9 to 12	0 to 20	y
81	m	29	47	0	0	100	12	9 to 12/ 9 to 12	0 to 20	y
82	m	30	0	0	0	100	0	Col /	20 to 40	y
83	m	30	0	0	0	100	0	Col / 9 to 12	40 to 60	y

(continued)

APPENDIX I (cont.)

Raw data: ages 31 to 35 mos.

Patient Number	Gender	Age in mo	D	M	F	S	T	EDU in Yrs Mother/Father	FAMILY INCOME by K ($1000)	City Water
84	m	31	0	0	0	100	0	Pcol /Col	60 to 100	y
85	f	31	22	0	0	90	6	9 to 12/		y
86	f	31	0	0	0	100	0	Col /	60 to 100	y
87	f	32	0	0	0	100	0	9 to 12/ Col	20 to 40	y
88	m	32	7	0	0	100	6	9 to 12/	0 to 20	y
89	f	32	0	0	0	100	0	/ Pcol	60 to 100	y
90	m	32	0	0	0	100	0	9 to 12/ 9 to 12	0 to 20	y
91	m	32	2	0	0	100	2	9 to 12/ 9 to 12	0 to 20	y
92	f	32	1	0	0	100	1	9 to 12/	20 to 40	y
93	m	33	1	0	0	100	1	9 to 12/ 9 to 12	0 to 20	y
94	f	33	0	0	0	100	0	9 to 12/	0 to 20	y
95	m	33	0	0	0	100	0	Col /	> 100	y
96	m	34	0	0	0	100	0	Col /	40 to 60	y
97	m	34	1	0	0	100	1	9 to 12/ 9 to 12	40 to 60	y
98	f	35	0	0	0	100	0	Col / 9 to 12	0 to 20	y
99	m	35	0	0	0	100	0	9 to 12/	20 to 40	y
100	m	35	16	0	0	100	7	Col / Pcol	60 to 100	y
101	m	35	0	0	0	100	0	Post Col/ Pcol	> 100	y
102	m	35	0	0	0	100	0	Col / Col	40 to 60	y

(continued)

APPENDIX I (cont.)
Raw data: ages 36 mos.

Patient Number	Gender	Age in mo	D	M	F	S	T	EDU in Yrs Mother/Father	FAMILY INCOME by K ($1000)	City Water
103	m	36	3	0	0	100	3	Col /	40 to 60	y
104	m	36	0	0	0	100	0	Col /	20 to 40	y
105	m	36	0	0	0	80	0	9 to 12/ Pcol	40 to 60	y
106	f	36	0	0	0	100	0	Col /	40 to 60	y
107	f	36	0	0	0	100	0	Col / Col		y
108	m	36	0	0	0	100	0	Col / Col	0 to 20	y
109	m	36	0	0	0	100	0	9 to 12/	0 to 20	y
110	f	36	0	0	0	100	0	Col /	60 to 100	y
111	f	36	0	0	0	100	0	9 to 12/	0 to 20	y
112	f	36	0	0	0	100	0	/ Col	20 to 40	y
113	m	36	0	0	0	100	0	Col / Col	60 to 100	y
114	f	36	0	0	0	80	0	9 to 12/		y
115	f	36	0	0	0	80	0	9 to 12/ <8	20 to 40	y
116	f	36	0	0	0	100	0	Pcol / Col	60 to 100	y
117	f	36	0	0	0	100	0	9 to12/ 9 to 12	0 to 20	y
118	f	36	0	0	0	80	0	Col / PCol	60 to 100	y
119	f	36	0	0	0	90	0	Pcol / Col	> 100	y
120	f	36	2	0	0	100	2	Col / Col	0 to 20	y
121	f	36	0	0	0	100	0		20 to 40	y
122	m	36	0	0	0	100	0	/ Pcol	40 to 60	y

(continued)

APPENDIX I (cont.)

Patients with unknown fluoride status

Patient Number	Gender	Age in mo	D	M	F	S	T	EDU in Yrs Mother/Father	FAMILY INCOME by K ($1000)	City Water
123	f	6	0	0	0	5	0	Col /	60 to 100	n
124	m	6	0	0	0	10	0	Pcol /	40 to 60	n
125	m	8	0	0	0	10	0	Col /		n
126	f	8	0	0	0	10	0	Col / Col	> 100	n
127	f	10	0	0	0	60	0			n
128	f	10	0	0	0	40	0	Col /	40 to 60	n
129	f	11	0	0	0	10	0	Col /	20 to 40	n
130	m	11	0	0	0	30	0	Col / Col	60 to 100	n
131	m	13	0	0	0	45	0	Pcol /	60 to 100	n
132	f	13	0	0	0	50	0	Col / Pcol	0 to 20	n
133	m	15	0	0	0	60	0	9 to 12/ 9 to 12	40 to 60	n
134	f	16	0	0	0	45	0	Col /	> 100	n
135	f	17	0	0	0	30	0	/ 9 to 12	20 to 40	n
136	f	17	0	0	0	90	0			n
137	m	18	0	0	0	60	0	Col / Col	60 to100	n
138	f	20	0	0	0	70	0	Col / 9 to 12	60 to 100	n
139	f	20	0	0	0	50	0	Col / Col	60 to 100	n
140	m	21	0	0	0	80	0	9 to 12/ Pcol	40 to 60	n
141	m	24	0	0	0	80	0	9 to 12/ Pcol	20 to 40	n
142	m	25	27	0	0	100	11		> 100	n
143	f	26	0	0	0	100	0	Col /	20 to 40	n
144	m	26	6	0	0	80	5	9 to 12/ 9 to 12	20 to 40	n
145	f	26	0	0	0	100	0	Col /	20 to 40	n
146	f	27	0	0	0	65	0	Col /	> 100	n
147	f	27	0	0	0	100	0	9 to 12/ Pcol	0 to 20	n
148	f	32	0	0	0	95	0	Col /	40 to 60	n
149	f	33	24	0	0	100	10	9 to 12/	20 to 40	n
150	m	36	32	0	0	100	14	<8 / 9 to 12	0 to 20	n

APPENDIX II

Results of dental caries prevalence surveys for children ages 6 to 36 months

			Percentage of Caries for All Children					
Investigator	Year	N	6-12 mos	13-18 mos	19-24 mos	25-30 mos	31-36 mos	Total
Ching (USA)	2000	150	4	0	22	23	26	16
Tang et al. (USA)	1997	5171	6.4	--	20	--	35	--
Kaste et al. (USA)	1996	654	--	[----------0.8----------]		--	--	--
Weddell (USA)	1981	441	0	4.2	10.23	19.79	36.4	15.42
Hennon (USA)	1969	756	--	--	8.3	34	45.2	50
Fulton (USA)	1952	761	0	--	--	--	--	--
Lopez (USA)	1998	167	4.4	11.1	21.4	[----------26.9----------]		--
Yonezu (Japan)	1998	374	--	6.1	14.7	--	31.8	--
Wendt (Sweden)	1991	632	0.5	[----------7.7----------]		--	--	--
Holt (England)	1988	348	--	[----------1----------]		[----------15----------]		--

APPENDIX III

Money income, Marion County*

Household Income Ranges	Percentage of Population
Less than $15,000	32.0
$15,000 to 24,999	25.3
$25,000 to 34,999	17.5
$35,000 to 49,999	15.0
$50,000 to 74,999	7.8
$75,000 or more	2.4

*An effort was made to select the most current household income data from the US Census Bureau for Marion County, Indiana. Percentages based on 1989 Census.

APPENDIX IV

Results of caries prevalence and socioeconomic status (ses) surveys for children ages 6 to 36 mos.

Investigator	Year	Correlation between Caries Prevalence and SES
Ching (USA)	2000	Marginally statistically significant. Low family income (below median, $0-20k) was related to higher caries experience. Lower father education attainment was related to higher caries experience. Statistically significant. Higher mother education attainment was related to lower caries experience.
Al-Hosani (Abu Dhabi)	1998	Statistically significant. High parental income was related to higher caries experience. Conversely, high parental education attainment was related to lower caries experience.
Infante et al. (USA)	1998	Statistically significant. Compared with children in the middle socioeconomic group, the lower status children of both urban and rural areas had greater caries experience.
Holt et al. (England)	1988	No significance.
Holt et al. (England)	1982	No significance.
Weddell (USA)	1981	No significance, although middle and middle-low socioeconomic groups had trends towards higher caries frequencies.
Winter et al. (England)	1971	Statistically significant. Based on father's occupation, there was a higher caries experience in the lower or unclassified socioeconomic groups.
Wisan et al. (USA)	1957	Statistically significant. The caries incidence was less in higher socioeconomic groups than in lower socioeconomic groups.

ABSTRACT

CORRELATION BETWEEN CARIES PREVALENCE AND SOCIOECONOMIC STATUS IN CHILDREN AGES 6 TO 36 MONTHS

by

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The purpose of this study was to evaluate the status of a sample of children ages 6 to 36 months with regard to prevalence of tooth decay in a community with an optimum fluoridated water supply. It was determined whether a relation existed between these data and the socioeconomic level of the family.

One hundred and fifty children ages 6 to 36 months born and reared in Marion County, Indiana were examined with a dental mirror, explorer and a portable light. Parents/legal guardians of these children were given a questionnaire to obtain family history.

Caries prevalence for children ages 6 to 12, 13 to 18, 19 to 24, 25 to 30, and 31 to 36 months were 4%, 0%, 22%, 23%, and 26%, respectively. Age, mother's educational attainment, and Medicaid experience remained significant predictors of caries experience: the odds of caries were 1.1 times for each monthly increase in age. Gender, father's educational attainment, family household income, and single parent status remained marginally significant predictors of caries experience.

Results for similar correlation studies between caries prevalence and socioeconomic status for children ages 6 to 36 months are inconsistent. Further research is needed for children ages 6 to 36 months. Caries experience begins before age one. Patients, parents, and health care professionals need to be aware that the caries process begins at an early age, and prevention should begin as early as 6 months of age.

CURRICULUM VITAE

Brent Bing Yee Ching

January 12, 1973	Born to Walter and Gwyneth Ching in Honolulu, Hawaii
1987 to 1991	Punahou Academy Honolulu, Hawaii
1991 to 1993	Wabash College Crawfordsville, Indiana
1993 to 1994	Indiana University Bloomington, Indiana
Summer 1996	Matsumoto Dental College Exchange Program Matsumoto, Japan
Fall 1997 to Spring 1998	Part-time Clinical Instructor: Dental Sciences I Indiana University School of Dentistry Indianapolis, Indiana
1998	DDS, Indiana University School of Dentistry Indianapolis, Indiana
August 1998	Hawaii Dental License Exam and Approval
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Professional Societies

Indiana Society of Pediatric Dentistry
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Achievements and Interests

Indiana Society of Pediatric Dentistry Award-Indiana University School of Dentistry
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Golden Key National Honor Society Award-Indiana University
Presidential Academic Scholarship-Wabash College